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Anachlorocurtis commensalis gen. nov., sp. nov. (Crustacea,
Decapoda, Pandalidae), a New Pandalid Shrimp
Associated with Antipatharian Corals
from Central Japan

With 3 Text-figures

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ABSTRACT A new pandalid shrimp, *Anachlorocurtis commensalis* gen. et sp. nov., is described from Central Japan. It is associated with antipatharian black corals and the first commensal shrimp in the family Pandalidae. *Anachlorocurtis* is readily distinguished from *Chlorocurtis*, to which the new genus is related, by the short and erect rostrum, two large teeth on the carapace and the reduced mouth-parts and branchiae.

During research on the commensal shrimps in Kushimoto, Kii Peninsula, Central Japan, several specimens belonging to the family Pandalidae are found in association with black corals, *Antipathes* spp. In this family only a single species, *Chlorotocella gracilis* Balss, has so far been reported in association with medusae (Hayashi and Miyake, 1968), but this association is thought to be accidental only, for many specimens are found under the free-living conditions (Bruce, 1973). The present species is unique morphologically as well as ecologically in the family Pandalidae and shows such specializations as the short and erect rostrum, two distinct large teeth on the middorsal line of the carapace, lack of mandibular palp, flagellum of the exopod of the first maxilliped, exopod of the second and third maxillipeds and the presence of a three-jointed carpus on the second pereiopod. According to the key given by Holthuis (1955), it is referred to *Chlorocurtis* Kemp in consequence of having short rostrum, no mandibular palp and a three-jointed carpus on the second pereiopod. The other features mentioned above, however, would prevent the inclusion of this species in *Chlorocurtis*, and would require to designation of a new genus and new species for these specimens.

Anachlorocurtis new genus

Definition. Small-sized shrimps associated with antipatharian corals. Body much compressed. Integument thin and rather fragile. Rostrum short and erect, with some secondary teeth on anterior margin in female, and with a few similar secondary teeth in male; the posterior tooth placed on posterior third of carapace, without any secondary tooth in either female or male. Antennal spine present; supraorbital and pterygostomial spines absent. Abdomen smooth; terga and pleura without any spine or spiniform process; lateral plate of sixth somite without spine. Telson with three pairs of small spines on lateral margin; posterior margin truncate with five pairs of spines. Eyes well developed, without ocellus. Antennular peduncle long; stylocerite short with spine on each outer and inner distal angle; upper and lower flagella uniramous and short. Scaphocerite well developed, broad with distinct distolateral spine, exceeded by lamella. Mandible without palp. Maxillula with palp, upper and lower lacinia. Maxilla with posterior lobe of scaphognathite rounded. First maxilliped with large palp; exopod without flagellum but with setose caridean lobe; epipod well developed, simple. Second maxilliped without exopod; epipod large and simple, without podobranch. Third maxilliped slender with epipod; exopod and arthrobranch absent. Pleurobranchs present on all pereiopods. First pereiopod slender, not chelate; ischium without lamellar expansion. Second pereiopod slender, with small chela; carpus three-jointed. Ambulatory pereiopods rather robust; dactylus slender, simple, without spinules on posterior margin; propodus with a few spinules on posterior margin; merus with subterminal spine on all ambulatory legs and one small spinule on middle of posterior margin in third and fourth pereiopods. Endopod of male first pleopod with long appendix interna. Endopod of male second pleopod with appendices interna and masculina. Endopod of female first pleopod a small lobule without appendix interna. Uropod normal.

Type-species: *Anachlorocurtis commensalis* sp. nov.

Systematic position. At first sight this new genus belongs to the *Chlorotocus* section of the family Pandalidae in having three carpal joints of the second pereiopod (Holthuis, 1955). The reduced branchial formula, including the lack of an exopod on the third maxilliped, and arthrobranchs or epipods on the pereiopods results in this genus being referred to *Chlorotocella* Balss or *Chlorocurtis* Kemp.

The features of the mouth-parts of this new genus, however, are unique and do not correspond to either of these genera. *Chlorotocella gracilis*, the type-species of this genus, was well described and excellently figured by Balss (1914) and *Chlorocurtis miser*, now a synonym of the only known species of this genus, *Cc. jactans* (Nobili), was described by Kemp (1925). The mandibular palp is absent in *Cc. jactans* but a two-jointed palp is present in *Ct. gracilis*. In the other characters the new genus is more closely related to *Chlorocurtis* than *Chlorotocella*; in the latter genus, the rostrum is long and slender and a supraorbital spine is present, while in

the former genus, like the present new genus, the rostrum is short and deep, though their shape and spination are different from each other, and no supraorbital spine is present. *Ct. gracilis* and *Cc. jactans* as well as other pandalids also have the exopod on the second maxilliped. In *Ct. gracilis* the flagellum of the exopod of the first maxilliped is well developed, while in *Cc. jactans* the presence of the exopod was mentioned but more details were not given by Kemp (1925) as for *Cc. miser*. As the absence of the flagellum is a most striking character of the family Pandalidae, if it was absent in *Cc. jactans* it is surprising that Kemp (1925) should not make reference to the fact.

Chlorocurtis and *Anachlorocurtis* are compared in the following table.

	<i>Chlorocurtis</i> Kemp	<i>Anachlorocurtis</i> new genus
Body:	stout	compressed, integument thin and fragile
Rostrum:	short and deep with fixed and movable teeth on dorsal margin	short and very deep, serrated on anterior margin in female and smooth in male
Carapace:	several postrostral teeth continuous with rostral one	two large teeth, considerably separated, anterior tooth serrated
Pterygostomial spine:	present	absent
First maxilliped:	normal, with flagellum on exopod	without flagellum on exopod
Second maxilliped:	normal	exopod absent
Second pereiopod:	three carpal joints transversely articulated	first joint obliquely articulated with second one
Sixth abdominal somite:	spine on lateral plate	no spine
Apex of telson:	pointed at middle, flanked by three pairs of spines	truncated with five pairs of spines

Apart from the members of the family Pandalidae the general body form and some features of the mouth-parts of this new genus resemble those of some genera of the subfamily Pontoniinae of the family Palaemonidae. The absence of the flagellum of the exopod of the first maxilliped and lack of exopod on the second and third maxillipeds are in accordance with *Hamodactyloides* Fujino, *Hamodactylus* Holthuis, *Pontonides* Borradaile, *Pseudocoutierea* Holthuis, *Veleronia* Holthuis and *Waldola* Holthuis. The species belonging to these six genera have a more or less compressed body. Of these genera *Veleronia* contains two species, both reported from the Atlantic Ocean, and their mouth-parts agree with those of the present new genus. In the other five genera, which contain only one or two species, the flagellum of the exopod of the first maxilliped is absent or reduced in each species. The species belonging to these genera are collected in association with or together with the milleporan hydroid (Fujino, 1973), the antipatharian sea whip (Davis and Cohen, 1968), the gorgonian, *Mopsella* (Bruce, 1970) or unidentified antipatharians or gor-

gonians (Holthuis, 1951, and Chace, 1972). The similarity of the body form, the mouth-parts and the host associations may indicate the similar feeding habit of these shrimps belonging to unrelated families, but detailed observations of their behavior have not been reported so far.

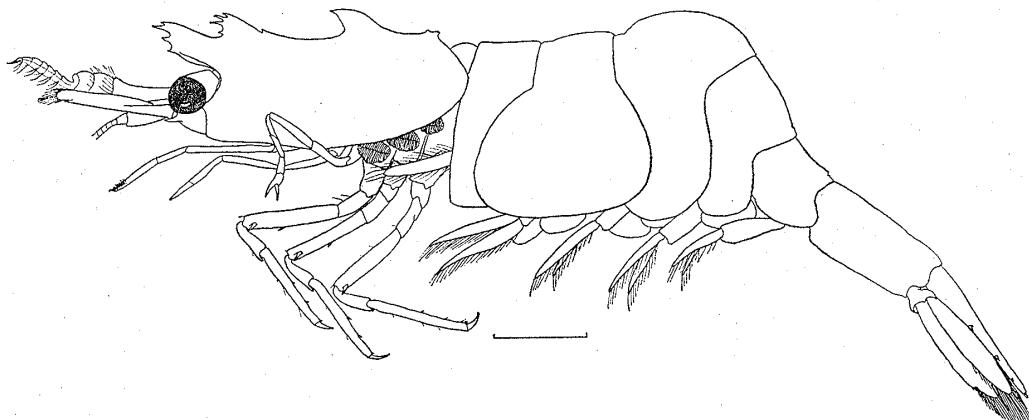


Fig. 1. *Anachlorocurtis commensalis* sp. nov. Holotype, female. Scale represents 1.0 mm.

Anachlorocurtis commensalis sp. nov.

(Figs. 1-3)

Strait between Ooshima and Kushimoto, southern Kii Peninsula, Japan, 15 m deep, July 1, 1972, host uncertain (probably antipatharian), K. Hayashi, T. Tatsuki, M. Irie, S. Nakamura leg.—1 ovig. ♀, 1 ♀ (paratypes); Dec. 27, 1972, host uncertain (probably antipatharian), K. Hayashi, I. Miyawaki, K. Okamoto, S. Nakamura leg.—1 ♂, 1 ovig. ♀, 3 ♀♀, 4 juv. (paratypes); Dec. 8, 1973, associated with *Antipathes japonica* Brook, K. Hayashi leg.—1 ♂, 1 ♀ (paratypes), Dec. 8, 1973, associated with *Antipathes* sp. K. Hayashi leg.—1 ♂, 2 ovig. ♀♀, 3 ♀♀, 1 juv. (paratypes).

Off Andonohana, Shionomisaki, southern Kii Peninsula, Japan, 8 m deep, Nov. 12, 1973, associated with *Antipathes* sp., K. Hayashi, I. Miyawaki leg.—1 ovig. ♀ (holotype).

Description. Female:— Small-sized shrimp of generally compressed body form. Rostrum short, deep and erect from dorsal margin of carapace, not reaching end of eye; anterior margin serrated with 2-6 small secondary teeth, of which upper second or third tooth extends furthest forward and reaches the rostral apex. Upper margin smooth and convex; lower margin smooth and straight or slightly convex. Carapace smooth, about twice as long as deep in lateral view, with two large triangular teeth in the middorsal line. Anterior tooth placed just behind rostrum and serrated with 2-4 small teeth as in rostrum; a small accessory tooth placed on base of anterior tooth. Large posterior tooth placed on posterior third of carapace, usually rather larger than anterior tooth and without any serration; apex pointed forward and anterior margin straight or rather convex; posterior (dorsal) margin

largely convex; a small tubercle usually present on middorsal line near posterior margin of carapace. Dorsal margin of orbit continuous with short dorsal midrib, which extends to middle of rostrum near lower margin. Antennal spine well developed. Supraorbital spine entirely absent. Pterygostomial angle quadrate, without any spine.

Abdomen smooth and compressed. Pleura of all somites rounded. Third somite produced posteriorly. Fourth and fifth somites with a faint transverse notch on dorsal surface near posterior margin. Sixth somite more than twice as long as fifth somite; posteroventral angle obtusely produced, but not spiniform; lateral plate ill-defined, only a small process. Telson slender, as long as sixth somite, with three pairs of small spines on lateral margin; first pair placed on middle of telson; following two pairs placed equally between first pair and distal end of telson. Posterior margin truncated with five pairs of subequal, rather long spines, except for outermost pair, which is short and resembles the dorsal spines; no distinct setae present on dorsal surface or posterior margin.

Eyes long and cylindrical, without ocellus; cornea well pigmented, twice as long as stalk, with a small tubercle near upper distal end.

Antennular peduncle long, without spine on any segment; basal segment long, more than twice as long as distal two segments combined, with several long marginal setae. Stylocerite short, falling short of middle of basal segment; outer margin nearly straight, ending in an acute spine; anterior margin concave; inner distal angle pointed forming a small spine, exceeded by outer distal spine. Distal two segments subequal, short and broad. Upper flagellum short, composed of about 10 segments; lower flagellum slightly shorter than upper flagellum and rather swollen in basal segments, of which three distal segments bear some long setae on lower surface. Antennal scale exceeding antennular peduncle by lamellar part, about three times as long as broad; outer margin straight, ending in a stout spine which falls distinctly short of the tip of lamella. Basicerite with a well developed distolateral spine; carpocerite cylindrical, reaching middle of scale. Flagellum slender, long, about half as long as body.

Mandible composed of molar and incisor processes; palp entirely absent; molar process with small teeth on distal end; incisor process slender and tapering with a few small irregular teeth apically. Maxillula with broad lacinia armed marginally with many plumose setae; palp truncated distally with two simple setae. Maxilla has short palp with two simple setae distally; scaphognathite well developed armed marginally with dense plumose setae and posteriorly obliquely truncated. Distal endite divided into two parts with plumose setae marginally; basal endite not divided and also with marginal plumose setae. First maxilliped unique in shape; epipod long, with two simple setae distally; exopod composed of caridean lobe with long marginal setae, but without any flagellum; endites separated by a faint incision, with sparse short plumose setae; epipod large and simple. Second maxilliped has a narrow terminal segment with more than ten stout, plumose setae;

a single plumose seta present near distal margin of merus; exopod totally absent; epipod large and subrectangular. Third maxilliped slender and long, nearly reaching end of antennular peduncle; epipod small, simple; antepenultimate segment long, 1.5 times as long as distal two segments combined; a setose convexity present on lower margin near base; ultimate segment slightly longer than penultimate segment, furnished with some rows of short setae on distal half of upper margin.

First pereiopod slender, not chelate, only reaching apex of rostrum; dactylus as long as each propodus and merus, with distal two-thirds somewhat flattened

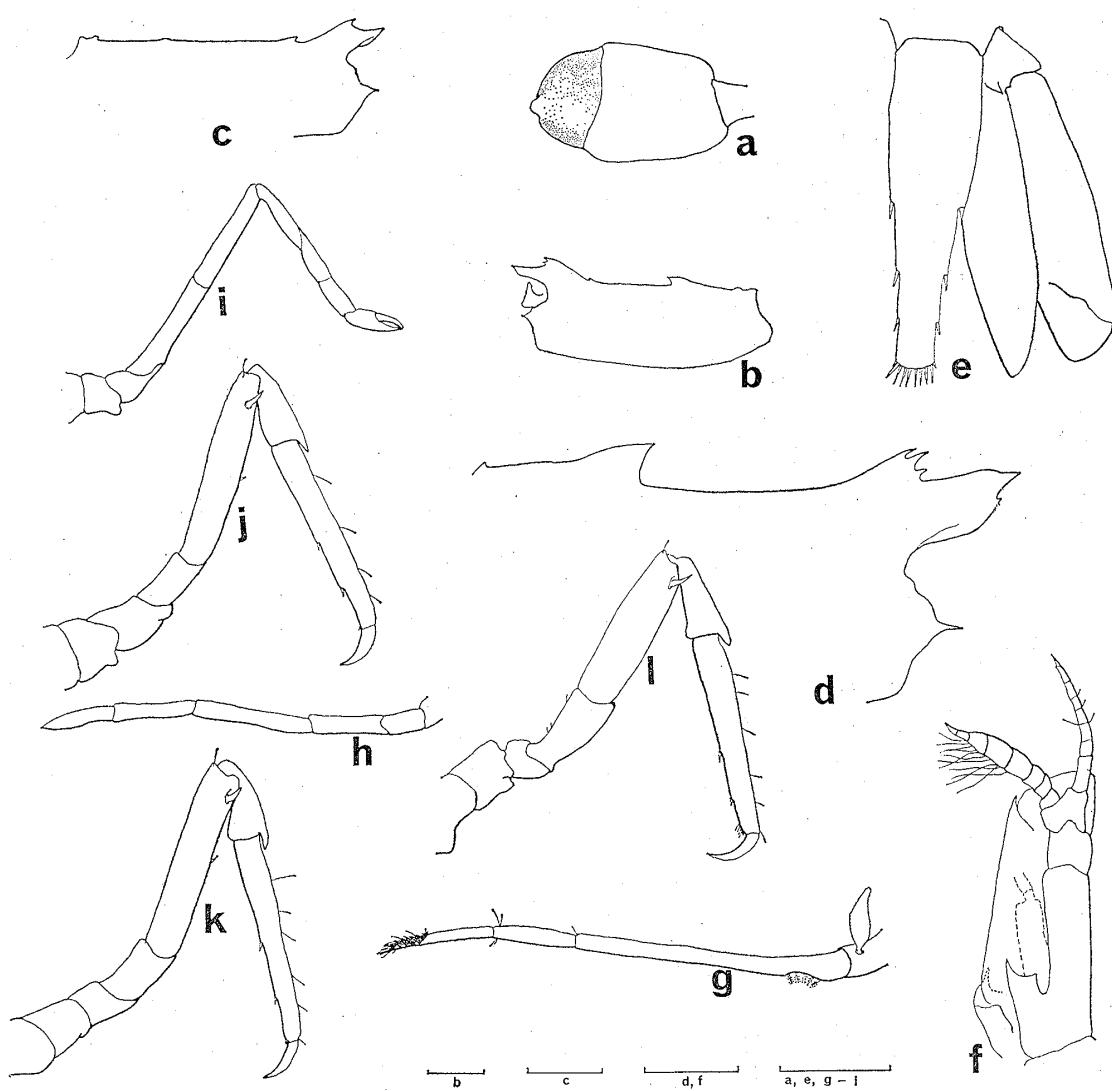


Fig. 2. *Anachlorocurtis commensalis* sp. nov.—a, Holotype; b, male, paratype, 1.8 mm in carapace length; c, juvenile, paratype, 1.7 mm in cl; d-l, female, paratype, 2.3 mm in cl. a, Eye in dorsal view, b-d, carapace, e, tail fan, f, antennular peduncle, g, third maxilliped, h, first pereiopod, i, second pereiopod, j, third pereiopod, k, fourth pereiopod, l, fifth pereiopod. Scales represent 0.5 mm.

dorsoventrally; carpus long, about as long as merus and ischium combined; ischium without lamellar expansion; all segments almost glabrous. Second pereiopod slender, chelate, reaching end of eye; chela small, spatulate, with a large gap between fingers; carpus about three times as long as chela, three-jointed, of which proximal joint obliquely articulated with the second joint; merus two-thirds length of carpus; ischium as long as merus. Following three pereiopods rather more robust than the former two pereiopods. Third pereiopod reaching end of antennal scale; dactylus slender, curved with a distinct unguis distally; propodus 3.5 times as long as dactylus, with three spines on distal half of posterior margin; carpus about half as long as propodus, anterodorsal end extending over base of propodus as a flat expansion; merus as long as propodus with a subterminal spine on lateral surface and with a very small spine on middle of posterior margin; ischium one-third length of merus, without any spine. Fourth pereiopod reaching end of eye and very similar to third pereiopod in shape and in spination of propodus and merus. Fifth pereiopod reaching rostral apex; dactylus and carpus similar to those of third and fourth pereiopods; propodus with a few, short simple setae near posterodistal end in addition to a short terminal spine; merus shorter, three-fourths length of carpus and armed with a subterminal spine only.

Endopod of first pleopod (female) short, one-third length of exopod, triangular, distal part rather elongated, with some plumose setae on proximal half of outer margin and with a very short spinule on distal third of inner margin. Uropod as long as or slightly shorter than telson; outer margin of exopod ending in a stout fixed spine exceeded by inner movable spine; diaeresis well marked. Sixth abdominal sternite with a preanal tubercle; fourth sternite with a median obtuse, thin keel.

Male and juvenile:— Generally similar to female, but the features of rostrum and carapace are rather different. Male much smaller and more slender than female. Rostrum only a rectangular tooth, not reaching end of eyestalk, without any secondary tooth on dorsal, ventral or anterior margins. Carapace smooth and slender, about 2.5 times as long as deep in lateral view; two middorsal teeth much smaller than those of female; anterior tooth with a few secondary teeth on anterior margin, and sometimes with a small accessory tooth near base of anterior tooth. Posterior tooth simple, without any secondary tooth as in female. Near posterior margin of carapace a small tubercle present as in female. Juvenile (or probably young female) as large as male. Rostrum only a small triangular tooth, with pointed apex. Anterior tooth on the carapace also like a small tooth without any secondary tooth, though with a small accessory tooth placed a little behind anterior tooth. Posterior tooth entirely absent or only represented by a small tubercle. A small tubercle present near posterior margin.

Abdomen longer and more compressed than in female. Sixth abdominal somite about 2.5 times as long as fifth somite in male and in juvenile.

Endopod of first male pleopod long, about half as long as exopod, with a few retinacula near apex, and with a few short simple setae. Endopod of second male

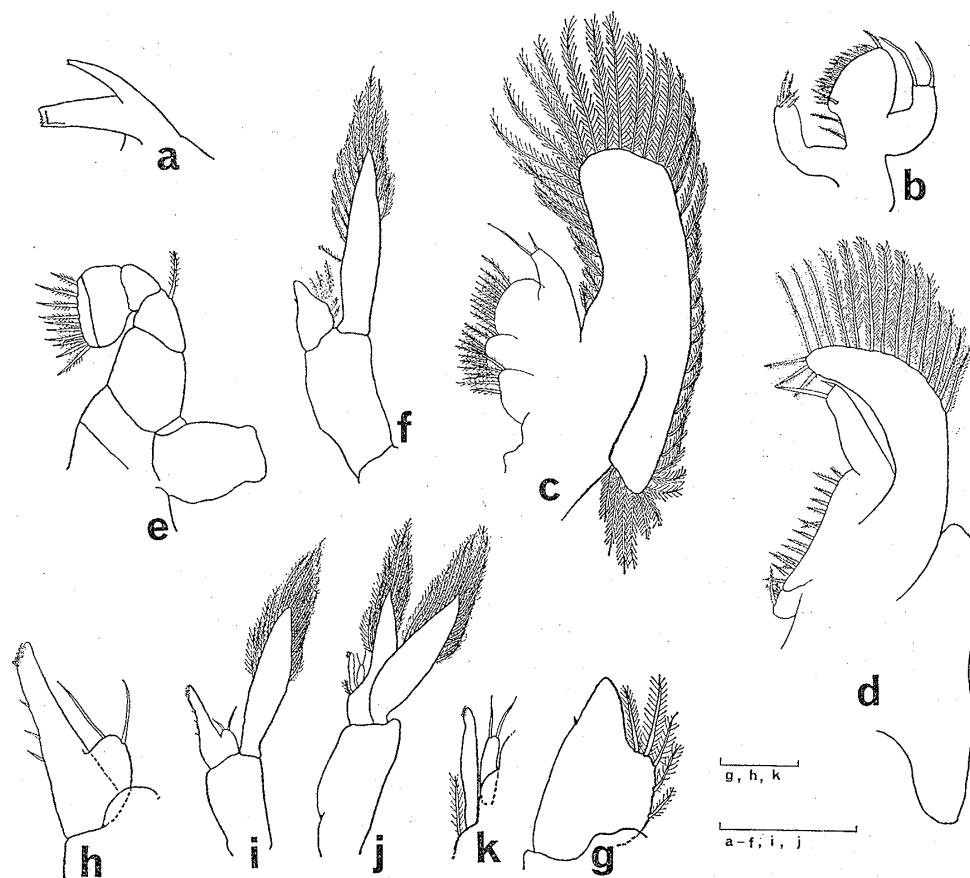


Fig. 3. *Anachlorocurtis commensalis* sp. nov.—a-g, Female paratype, 2.3 mm in carapace length; h-k, male paratype, 1.8 mm in cl. a, Mandible, b, maxillula, c, maxilla, d, first maxilliped, e, second maxilliped, f, i, first pleopod, g, h, endopod of first pleopod, j, second pleopod, k, appendices interna and masculina. Scales represent 0.25 mm.

pleopod as long as exopod; appendix masculina short, with two simple setae near apex; appendix interna long, with a few retinacula near apex; a long plumose seta placed on base of appendix interna.

Size. The holotype (ovigerous female) is 2.2 mm in carapace length and about 12 mm in total length. The ovigerous females vary from 2.2–3.0 mm in post-orbital carapace length. The largest male is 1.8 mm in carapace length. The eggs are 21–75 in number per female, $0.32\text{--}0.40 \times 0.40\text{--}0.60$ mm in diameter.

Host. The shrimps, at first, were found in the bottom of a large plastic tank, which is used for the transportation or the short term rearing of many invertebrates freshly collected. Thus, the host of this shrimp was not certainly known at that time, but some coelenterates were considered as a host of the shrimp, because the shrimp was found, only when some gorgonians and antipatharians were collected. Subsequently, whenever I dived for collecting invertebrates, I carried sample bags made of cloth, into which each colony of gorgonians or antipatharians was put

separately. These shrimp could not be found in bags containing other coelenterates or invertebrates, but only in those containing tree-like antipatharians. The Japanese fauna of the antipatharian corals is very obscure, and the present hosts can probably be two species identified as belonging to the genus *Antipathes*; one is *A. japonica* Brook, which has a white coenosarc and polyps, and the other is *Antipathes* spp., in which the coenosarc and polyps are light brown. No shrimp could be found on any other antipatharians, such as the sea whip, *Cirripathes*.

Under water the individuals of this new species could not be detected on the colony of the antipatharian hosts, but some other decapods, *Chirostyrus dolichopus* Ortmann and *Xenocarcinus* spp. were sometimes found. Two pontoniine shrimps, *Periclimenes psamathe* (de Man) and *P. sinensis* Bruce, were each found once in the same sample bag together with this new pandalid, though the above mentioned anomuran and brachyuran decapods were always found in association with *Antipathes* spp.

Colour. In female, the specimen is generally transparent and furnished irregularly with some reddish purple and white lines or patches. A short, transverse reddish purple line is present on the posterior base of either tooth on the carapace and there are also small patches of the same colour on the posterior end of the orbit, middle of the gastric region, the border between the hepatic and the branchial regions. A rather broad line of reddish purple runs laterally through the center of first to the third abdominal pleura. The middorsal line of the entire second and the anterior two-thirds of the third somite is seen as a reddish purple tint through the integument. There are small reddish purple patches on the posterior end of the third somite and the anterior part of the fourth somite, which is usually overlapped by the produced end of the third somite. Furthermore, in the second and third somites the bases of the pleura are reddish purple. In the posterior three somites the reddish purple line is seen through the integument to run along the intestine. In the fifth and sixth somites a short transverse line of white colour is present near the posterior margin. There are two transverse white lines on the middle and near the posterior margin of the telson and three similar white lines on basal, middle and posterior parts of the uropod. The outer surface of the eyestalk and inner half of the antennular peduncle and a few basal joints of the inner flagellum are also reddish purple. The colour of the antennal scale is pale, though having rather darker inner half. The third pereiopod rings a narrow white band at the articulation between carpus and propodus, and the distal part of the merus. There are similar white rings on the middle of the merus in the fourth pereiopod, and on the middle of the merus and the ischio-meral articulation in the fifth pereiopod. Similar reddish purple rings are present on the middle of both propodus and merus, and the base of fourth pereiopod, and also present on proximal part of the propodus and the middle of the merus in the fifth pereiopod.

In male the specimen is more transparent and only small reddish purple patches are scattered sparsely and no white colour patch is present. The carapace and

abdomen are entirely transparent, except for the posterior end of the orbit which is reddish purple. In the abdominal somites a reddish purple line runs from the first somite to, usually the fifth or rarely, to the apex of the telson along the middle line of the sternites. The antennular peduncle and the eyestalk are reddish purple but basal part of the inner flagellum of the first antennal and the entire antennal scale are transparent. Basal part of the fourth pereiopod is reddish purple. In the second and the following three pleopods the inner side of the protopod is reddish purple.

These colour patterns are based upon the specimens collected on December 27, 1972, from probably a white type of *Antipathes*. In the shrimps from a brown type of *Antipathes*, the colour markings of reddish purple mentioned above seem to be rather brownish.

Remarks. Almost all the species in the family Pandalidae are known to show the free-living life form. Only one exception, *Chlorotocella gracilis* Balss, was reported in association with the medusa, *Mastigias papua* Agassiz (Hayashi and Miyake, 1968). *C. gracilis*, however, is frequently found under the free-living conditions in shallow tropical waters (Bruce, 1973) and from the plankton samples in Japan (Hayashi and Miyake, 1968), and therefore, Bruce (1973) considers the association between *C. gracilis* and the medusae to be accidental only.

The present new pandalid, *Anachlorocurtis commensalis*, on the contrary, is always collected together with the black corals and actually found in association with two species of *Antipathes*. It shows many structural modifications, such as the small and compressed body, the smooth and softened integument and the reduction of the mouth-parts and the branchiae, and also carries comparatively large and few eggs. The coloration of this shrimp is well blended to that of the host tissue. These features in *A. commensalis* are in accordance with the adaptive characters of the true ecto-commensal shrimps belonging to the subfamily Pontoniinae of the family Palaemonidae. Moreover, there is no significant harmfulness on the colony of the host *Antipathes* spp., from which several specimens of the new pandalid are obtained. These facts seem to show that this new pandalid is the obligate commensal with the antipatharian black corals.

Distribution. The species has only been known from the southernmost point of the Kii Peninsula, Central Japan, at the depths of 8–15 m.

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